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RELATIONSHIPS OF IRRIGATION REGIMES AND INTERCROPPING WITH PEST INFESTATION OF TOMATO IN FAYOUM, EGYPT*

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ABSTRACT

This investigation was conducted at Fayoum (Egypt) during the 1999 tomato growing winter season. Large numbers of insect species were recorded on tomatoes and other plants intercropped with it. Of these, several species were not pests of any significance and were either accidental in their occurrence or resting/sheltering on the plants. However, some other insects cause injury to several plants, for example: aphids, whitefly, jassids, thrips, spider mites and leafminers. The inter-cropping of faba bean and termis with tomatoes irrigation with normal regime have reduced the infestation of aphids on tomato plants. The significant interaction between irrigation regimes and type of plant inter-cropping shows that all insect pest populations were jointly influenced by these two factors.

INTRODUCTION

Inter-cropping, i.e. cultivation of two, or more, crops in the same field, is now a highly recommended practice in order to break the monotony of monocultures, and thereby preventing the spread of pests from one plot to another. When trying to cross into neighboring plots, pests find an unsuitable plant, or one to which they are not adapted, in their way,. In this way, the use of pesticides can be substantially reduced. This practice is being encouraged in Egypt, since, according to FAO yearbooks, great amounts of pesticides have been applied during the last half-century

In order to reduce the use of pesticides in agriculture, the methods of intercropping (or trapcropping) may be useful in hindering the movement of pests from a row of crop to a neighbouring row of the same crop, by erecting alternative rows of a different crop. Such method proved good results in the Fayoum Governorate, using wheat and clover (Ghabbour *et al.* 1994). Some problems may still appear in the probable proliferation of some pest species, and more studies are needed to evaluate the efficiency of intercropping as a method

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to reduce the spread of such pests. Trapcropping remains under-exploited and its study has been very limited. It deseves more attention to sustain agro-ecosystems throughout the world (Javaid and Joshi 1995). Another important factor in the spread of pests is the amount of irrigation water used (Mikhail *et al.* 1998). Therefore the present experiment was carried out to examine the effect of both the intercropping and the irrigation regimes using tomato inter-cropping with *Vicia faba* bean and *Lupinus termis* on pest infestation.

MATERIAL AND METHODS

The experiment was conducted in Ebgig village, Fayoum Governorate. The field was divided into a split plot design with four replicates with a total area of 1400 m^2. The sub-plot area was 18 m^2, and each comprised five terraces of 2 m length and 1m width.

The plots were subjected to irrigation treatment and sub-plots were planted with inter-cropping systems as follows:

1-Main-plots. (irrigation).

A1 irrigation every 3 weeks.
A2 irrigation every 4 weeks.
A3 irrigation every 5 weeks.

2-Sub-plots (inter-cropping)

I. Tomato
II. Tomato + *Vicia faba* (faba bean)
III. Tomato + *Lupinus termis* (termis)

Tomato plants (super Marmar variety) were transplanted on November 14th at both sides of the terraces in hills of 40 cm. whereas *Faba* bean and termis seeds were sown on November 19th in rows over the terraces in ridges 15 cm apart. Counts of pests are as individuals/leaf or square inch.

To evaluate the effect of intercropping systems and irrigation regimes on the infestation of tomato pests, Duncans multiple range test was used for each pest species as described by Snedecor (1970).

RESULTS

In this experiment, the effect of intercropping systems and irrigation regimes of tomato, faba bean, and termis on the population densities and rates of infestation by tomato major pests was studied. The results are presented in Tables 1-7.

1-Effect on aphids *(Aphis gossypii)* infestation

Data presented in Tables 1 and 2 show that populations of *Aphis gossypii* (adults and nymphs) varied significantly with dates and cropping system. These two factors jointly influenced aphid population densities. The population level was generally higher in tomato monoculture than in mixed cultures (tomato mixed with either faba bean or termis). Irrigation regimes had insignificant

effect on the number of adults while nymphs were significantly increased with increasing irrigation. The intercropping with different plants reduced the infestation with aphids. There was a significant interaction between irrigation regimes and intercropping systems, indicating that the aphid population density was jointly influenced by these two factors.

2- Effect on whitefly (*Bemisia tabaci*) infestation

Table 3 shows the levels of infestation by the whitefly *Bemisia tabaci*. There was a significant difference between dates. High infestation was recorded in March 1999. On the other hand, the intercropping of tomato with faba bean or termis decreased the whitefly infestation, while the irrigation regime had no significant effect. The interaction of irrigation regimes and intercropping system had a significant effect on infestation by this pest. Tomato monoculture had a high infestation with whitefly. The reduction of irrigation reduced the rate of infestation.

3-Effect on thrips infestation

Table 4 shows the rates of infestation by thrips. Effect of dates, irrigation regimes and the intercropping system on pest infestation was not significant. The interaction of irrigation regimes and intercropping systems on thrips infestation was significantly different. Tomato monoculture with a surplus amount of irrigation was highly infested and the infestation decreased as the amount of irrigation decreased. In tomato intercropped with faba bean or termis, the infestation by this pest decreased as the amount of irrigation was reduced.

4-Effect on jassids (*Empoasca* spp.) infestation

Table 5 shows the infestation rate by the jassid *Empoasca* spp. There was a significant difference between dates. High infestation was recorded in January 1999. The effect of intercropping system, irrigation regimes and the ineraction on pest infestation of the jassids was not significant.

5-Effect on leafminer (larvae) infestation

Table 6 shows the levels of infestation by leafminer larvae. The effect of dates and irrigation regimes on pest infestation was not significant. The effect of the intercropping system on pest infestation was significant. Tomato monoculture was highly infested with leafminer. The infestation was decreased in tomato intercropped with either faba bean and termis.

6- Effect on spider mites (*Tetranychus* spp.) infestation

Table 7 shows the rates of infestation by spider mites, *Tetranychus* spp. The effect of irrigation regime, intercropping system and their interaction on spider mite infestation was not significant. The effect of dates on infestation of

the spider mite was significant. A high infestation rate was recorded in March 1999.

DISCUSSION

There have been many studies on the effects of the intercropping diversity on insect populations, and in a survey, Rish *et al.* (1983) revealed that of almost 700 herbivorous species studied, 53% showed a decrease, 18% increased, 29% varied in response.

The abundance, distribution and attractiveness of various host plants may vary in space, type of plant, and irrigation regimes. This may affect the overall population dynamics of the pest and the degree of attack. In the present study, it could be concluded that the intercropping of tomatoes with other different plants on one hand and the irrigation regime on the other hand are substantial factors influencing pests infestation on tomatoes. Ali *et al.* (1994) indicated that mixed culture proved to be much better than monoculture in soybean with maize. However, Ibrahim *et al.* (1996) found that polyculture systems showed significant increase in the population density of aphidophagous insects than in cow pea or maize mono-crop. Afifi *et al.* (1990) indicated that growing tomato with onion or garlic decreased the aphid population by 86-87%. The results of the present experiment revealed that growing tomato with terims (*Lupinus*), and *Faba* bean decreased the aphids population by 86% and 38%, respectively. This may be related to general differences in plant shape, texture and leaf structure. Hailu *et al.* (1997) stated that aphids were significantly greater in mono-cropped bean than in bean associated with hedgerows. Afifi and Haydar (1990) indicated that intercropping onion and garlic with tomato decreased the level of thrips infestation by 79-86%.

The present study showed that irrigation can be directly harmful to some pests especially thrips, which decreased in number to 37.5% in monocrop and to 60% in intercrop. Also Suresh *et al.* (1993) studied the effect of intercropping of coriander, cow pea, black grass, green grass, soya beans and sorghum on bollworms infestation on cotton, and found that cotton intercropped with cow pea showed the least damage to cotton (22.5%), while the greatest damage was observed in cotton monoculture (64.5%).

Karel *et al.* (1982) stated that insect pest counts and damage were higher in pure stands than in mixtures, and maize acted as a barrier to the dispersal and entry of many pests in the mixture. The present work indicated that jassids pest counts were higher in monoculture tomatoes (80%) than in tomatoes intercropped with faba bean (28%) and *Lupinus* (19%).

Also Perfect *et al.* (1978) in Nigeria and Karel *et al.* (1982) in Tanzania showed that populations of *Emposica olichi* were reduced in cow pea-maize intercropping. Similarly, Giga *et al.* (1989) indicated that, significantly more jassids were recorded in pure cow pea stand, than in the intercrops. Roltsch and Gage (1990) studied the influence of tomatoes intercropped with bean on populations of *Emposca*, and indicated that the inter-crop reduced the number of

the pests because eggs were laid on plants containing the greatest amount of total nitrogen. The mechanisms of plant selection for some insects but others as yet have hardly been investigated. Chemical composition of plants is of great importance in guiding the insect in the selection process. Volatile chemical constituents may attract or repel insects from distance and should contact due to other chemicals, which stimulate or deter feeding or egg laying.

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Table (1) Numbers of *Aphis gossypii (adults)* collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Dates	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	23	22	26	36	26	10	38	22	22	25.0 bc
Jan. 99	10	16	26	14	12	10	22	12	12	14.9 c
Feb.	22	8	12	20	14	4	16	14	16	15.1 c
Mar.	32	44	92	104	18	50	38	15	36	47.7 ab
Apr.	70	26	82	142	0	76	20	32	18	51.8 a
Interaction	33.4 bc	23.2 bc	47.6 ab	63.2 a	14.0 c	30.0 bc	26.8 bc	19.0 c	20.8 bc	
Irrigation	21 days = 34.7 a			28 days = 35.7 a			35 days = 22.2 a			
Crop	TS = 41.1 a			TF = 18.7 b			TL = 32.8 ab			

LSD at $P = 0.05$
Dates = 23.6 Irrigation = 18.3
Crop = 16.4 Interaction = 28.3

Table (2) Numbers of *Aphis gossypii* (nymphs) collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Date	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	70	29	12	28	28	24	14	18	16	26.6 c
Jan. 99	58	48	10	16	34	18	34	18	2	26.4 c
Feb.	154	18	90	56	4	46	62	12	46	54.2 b
Mar.	98	41	204	250	50	112	48	24	120	94.3 a
Apr.	4	4	10	14	0	22	6	16	4	8.9 c
Interaction	76.8 a	28.0 bc	65.2 ab	53.2 bc	23.2 bc	44.4 bc	32.8 bc	17.6 c	37.6 abc	
Irrigation	21 days = 65.7 a			28 days = 40.3 ab			35 days = 24.3 b			
Crop	TS = 54.3 a			TF = 22.9 b			TL = 49.1 ab			

LSD at $P = 0.05$
Dates = 27.2 Irrigation = 21.0
Crop = 26.9 Interaction = 46.3

Table (3) Numbers of *Bemisia tabaci* (nymphs) collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Date	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	10	4	14	10	0	14	20	0	0	8.0 ab
Jan. 99	4	4	2	4	6	0	12	10	2	4.9 b
Feb.	18	2	4	18	0	2	4	6	4	6.4 ab
Mar.	24	7	6	22	6	4	12	0	12	10.3 a
Apr.	24	2	2	4	5	2	0	0	0	4.6 b
Interaction	16.0 a	3.8 bc	5.6 bc	11.6 ab	3.4 c	4.4 bc	9.6 abc	3.2 c	4.0 bc	
Irrigation	21 days = 8.5 a			28 days = 6.5 a			35 days = 5.6 a			
Crop	TS =12.4 a			TF = 3.5 b			TL = 4.7 b			

LSD at $P = 0.05$
Dates = 4.7 Irrigation = 3.7
Crop = 4.7 Interaction = 8.1

Table (4) Numbers of Thrips (nymphs) collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Date	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	0	0	0	0	2	2	0	4	2	1.1 a
Jan. 99	6	8	0	0	0	0	2	0	0	1.8 a
Feb.	6	2	4	4	0	2	2	0	0	2.2 a
Mar.	2	2	0	0	0	0	2	0	0	0.7 a
Apr.	2	0	0	0	0	2	0	0	0	0.4 a
Interaction	3.2 a	2.4 ab	0.8 b	0.4 b	1.2 ab	1.2 ab	1.2 ab	0.8 b	0.4 b	
Irrigation	21 days =2.1 a			28 days = 0.8 a			35 days = 0.8 a			
Crop	TS = 1.7 a			TF = 1.2 a			TL = 0.8 a			

LSD at $P = 0.05$
Dates = 2.6 Irrigation = 2.0
Crop = 1.2 Interaction = 2.1

Table (5) Numbers of *Empoasca lubica* (adults) collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Date	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	0	0	0	0	0	0	0	0	0	0.0 b
Jan. 99	46	72	16	50	56	22	78	36	70	49.6 a
Feb.	0	0	0	0	0	0	0	0	0	0.0 b
Mar.	0	2	2	0	0	4	2	2	0	1.3 b
Apr.	0	0	0	4	0	2	0	0	0	0.9 b
Interaction	9.2 a	18.8 a	3.6 a	10.8 a	11.2 a	5.6 a	16.4 a	7.6 a	14.0 a	
Irrigation	21 days = 9.2 a			28 days = 9.2 a			35 days = 12.7 a			
Crop	TS =12.1 a			TF = 11.2 a			TL = 7.7 a			

LSD at $P = 0.05$
Dates = 8.7 Irrigation = 6.8
Crop = 7.9 Interaction = 13.7

Table (6) Numbers of leafminer (larvae) collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Date	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	2	0	2	0	0	2	0	0	0	0.7 a
Jan. 99	3	0	2	0	0	0	0	0	0	0.6 a
Feb.	0	2	2	0	0	0	0	0	0	0.4 a
Mar.	4	0	0	4	0	0	2	0	0	0.1 a
Apr.	0	0	0	4	0	2	0	0	2	0.8 a
Interaction	1.8 a	0.4 ab	1.2 ab	1.6 a	0.0 b	0.8 ab	0.4 ab	0.0 b	0.4 b	
Irrigation	21 days = 1.1 a			28 days = 0.8 a			35 days = 0.3 a			
Crop	TS = 1.3 a			TF = 0.1 b			TL = 0.8 ab			

LSD at $P = 0.05$
Dates = 1.4 Irrigation = 1.1
Crop = 0.9 Interaction = 1.6

Table (7) Numbers of *Tetranychus* collected from the different plots under different irrigation systems (TS = tomato, TF = tomato + faba bean, TL = tomato + termis). Figures are calculated as the means of the collection weeks for each month.

Date	21 days			28 days			35 days			Mean
	TS	TF	TL	TS	TF	TL	TS	TF	TL	
Dec. 98	0	4	0	0	0	0	0	0	0	0.4 b
Jan. 99	0	0	0	0	0	0	0	0	0	0.0 b
Feb.	0	0	0	0	6	0	0	0	0	0.0 b
Mar.	0	12	10	40	0	0	0	24	20	11.8 a
Apr.	0	0	0	0	0	0	0	0	0	0.0 b
Interaction	0.0 a	3.2 a	2.0 a	8.0 a	1.2 a	0.0 a	0.0 a	4.8 a	4.0 a	
Irrigation	21 days = 1.7 a			28 days = 2.7 a			35 days = 2.9 a			
Crop	TS = 2.7 a			TF = 2.7 a			TL = 2.0 a			

LSD at $P = 0.05$
Dates = 3.5 Irrigation = 2.7
Crop = 5.3 Interaction = 9.1

العلاقة بين نظام الرى والتنوع المحصولى والاصابة الحشرية لمحصول الطماطم بالفيوم

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اتجهت الدراسات كثيرا فى العقد الأخير نحو دراسة تأثير التنوع المحصولى على خفض تعداد الآفات نتيجة التداخل بين المحاصيل المحملة المختلفة .وقد أوضحت الدراسات أن التنوع المحصولى يمكن ان يتحكم فى اعداد الآفات عن زراعة المحصول الواحد ، لأن النظام المركب يؤثر فى اعداد الحشرات ، اما نتيجة تداخل النباتات فتصعب حركتها أو زيادة أعدائها الطبيعية .وبهذه الطريقة يمكن أن نخفض من استخدام المبيدات . ومن المعروف أن مصر تشجع حاليا سياسة المكافحة المتكاملة للآفات من أجل خفض إستخدام المبيدات ، ونظرا لأهمية المياه واقتصاديات مياه الرى فقد تم دراسة العلاقة بين الاحتياجات المائية مع الزراعة المختلفة وتأثيرها على التحكم فى انتشار الآفات .

وقد أجريت الدراسة فى موسم ١٩٩٨-١٩٩٩ لتحقيق هذا الغرض حيث إن الطماطم محصول تصديرى هام فى محافظة الفيوم ، والطريقة التى اتبعت هنا هى : زراعة الطماطم بدون تحميل و طماطم محملة بالفول و طماطم محملة بالترمس ، مع استخدام ثلاثة طرق للتحكم فى الرى : رى كل ٢١ يوما (العادى) ، رى كل ٢٨ يوما ، رى كل ٣٥ يوما .

وقد أوضحت النتائج علاقة كمية مياه الرى مع الزراعة المختلطة وإنخفاض تعداد الآفات بنسب متفاوتة حسب نوع المحصول المحمل ، كذلك خفضت النباتات المحملة من حركة الآفة وانتقالها من نبات الى آخر من نفس النوع لوجود نباتات أخرى ليست عائلة لها فى طريقها.